

Rice Pest Management Alliance - Final Report of 2000 Activities

Contract Number: 98-0327

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Disclaimer

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Acknowledgments

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Abstract

The Rice Water Weevil is the most important insect pest of rice in California. Adults of this pest fly in the spring from overwintering sites to newly-flooded rice fields. Control of rice water weevil is primarily with insecticide applications which are timed between the time of adult infestation into fields and egg-laying (the insecticides effect adults and have no effect on the damaging larval stage). Therefore a greater understanding of rice water weevil flight, development of field populations, oviposition, egg hatch, etc. is needed to facilitate control efficacy. This study evaluated rice water weevil flight utilizing fifteen light traps across the Sacramento Valley rice production area in 2000. Insects were collected from the traps two to three times per week and the rice water weevils were separated. Data were placed on the UC Cooperative Extension Rice web site for grower assess as well as provided through the county-based Rice Farm Advisors. A total of 18,105 rice water weevil adults were collected. The first flight in Butte county began in early April and in the other counties the third week in April. Major flight peaks for all sites were 20 April, 23 April through 8 May and 17 to 24 May.

Executive Summary

The Rice Water Weevil, *Lissorhoptrus oryzophilus*, (RWW) is the most important insect pest of rice in California. Feeding by the larval stage of this insect on rice plant roots can reduce grain yield by up to 30%. Biological control and host plant resistance in the rice plant are nonexistent for this pest, although efforts and progress has been made in the latter area. Cultural control measures are useful to provide partial control, although these methods all have drawbacks such as potential to reduce yields, increased weed problems, increased production costs for fuel, etc. Therefore, insecticides are an important tool for the management of this pest. Carbofuran (Furadan® 5G) has typically been applied to 30-40% of the acres to manage this pest. The registration of this product has been under scrutiny since the early 1990's and in 1999 two new products were registered for RWW control. Therefore, 1999 was the last year of significant carbofuran use in rice (on-hand inventories were used in 2000). Furadan was applied pre-plant to rice fields; the two new products (Warrior® T and Dimilin® 2L) are applied after flooding and seedling emergence. Unlike Furadan (which killed RWW larvae), the effects of these new products is aimed at the adult RWW; they control RWW by preventing the deposition of viable RWW eggs. The occurrence of the damaging larval stage is hopefully prevented by stopping the deposition of RWW eggs. Dimilin and Warrior both have a short residual on the pest (less than 1 week). Therefore, the application has to be timed properly to facilitate control - too early and the material has dissipated too soon whereas with an application made too late and the RWW adults have already deposited eggs. Our results in small plot studies and grower fields have been promising with these products.

A greater understanding of RWW flight, development of field populations, oviposition, egg hatch, etc. is needed to facilitate control efficacy. Adults of this pest overwinter in protected areas and fly in the spring from overwintering sites to newly-flooded rice fields. The weevils fly primarily in the evenings (~7-11 pm) with perhaps a minimal amount of flight in the early morning. The conditions which favor flight include evenings with spring temperatures greater than 70 F°, fairly high humidity, and calm winds. RWW will not fly if these conditions are not met. An improved understanding of this flight was the goal of this project. Adult weevils are attracted to and can be collected with light traps. A light trap has been operated at the Rice Experiment Station for ~40 years to monitor RWW flight and to compare among years. The objective of this project was to expand the present light trap effort for RWW so that the data may provide "real-time" estimates of rice water weevil flight incidence and timing.

Fifteen light traps were placed throughout the Sacramento Valley rice production area as follows: three in Butte Co., four in both of Sutter and Colusa Co., two in Glenn Co., and one in both of Sacramento and Yuba Co. Insects were collected from the traps two to three times per week and the rice water weevils were separated and counted generally within 3 days of collection. Data were placed on the UC Cooperative Extension Rice web site (<http://agronomy.ucdavis.edu/uccerice/product/rwwtrap.htm>) in a timely fashion. This allowed growers and PCAs to investigate the RWW flight in their area and to reference this information when determining the need for and timing of insecticide applications. Obviously, specific information from each individual field was also critically needed before making these management decisions.

A total of 18,105 rice water weevil adults were collected. The 1st flight in Butte county began in early April and in the other counties the 3rd week in April. Major flight peaks for all sites were 20 April, 23 April through 8 May and 17 to 24 May. RWW spring flight totals for the light traps at cooperating grower farms involved were for Butte, 11,474; Colusa, 859; Glenn, 1,178; Yuba, 18; Sacramento, 6 and Sutter, 410. Overall, the flight incidence was higher in the northern counties than in other areas. RWW flight generally occurred earlier (peaked in April) at the “perimeter” of the Valley as opposed to the interior which peaked in May. Calculating when 90% of the flight was completed provides a means of comparing flight across years. The date when 90% of the flight was completed for RES was about 23 May, compared with 30 May in 1999. Therefore, 2000 could be classified, in terms of RWW flight, as a slightly earlier year and higher in number.

Body of Report

Objective 1: Expansion of the present light trap effort for rice water weevil so that the data may provide “real-time” estimates of rice water weevil flight incidence and timing.

Cooperator: Larry Godfrey, Dept. of Entomology, UC-Davis

Introduction: The Rice Water Weevil, *Lissorhoptrus oryzophilus*, (RWW) is the most important insect pest of rice in California. This insect overwinters as adults within protected areas (fencerows, levees, rice stubble, riparian areas, etc.). This occurs from about September to March and the adults are in a diapause state, i.e., nonreproductive. This diapause is broken by a set of undetermined environmental factors and the adults become active and feed on grassy weeds during the late winter/early spring. This feeding is necessary for them to develop their muscles which enables flight. Flight takes place from late March to June, but only under specific conditions. The weevils fly primarily in the evenings (~7-11 pm) with perhaps a minimal amount of flight in the early morning. These flight conditions include evenings with spring temperatures greater than 70 F⁰, fairly high humidity, and calm winds. The flight aim is newly flooded rice fields or probably weedy levees near rice fields. The adults, once in a newly flooded field with emerging rice, oviposit in the rice leaf sheaths below the water surface. Prior to oviposition, they feed on the leaf tissue in order to fully develop their eggs. These eggs hatch in about a week and the larvae drop to the soil surface and crawl to the rice roots to feed. This root feeding can greatly stunt rice plant growth, development, and yield. Yield losses as high as 30% have been noted with extreme RWW infestations (Godfrey and Parang 1996). Pupation also occurs on the roots, within a mud cell, in July. The newly-formed adults emerge in August, feed some on the rice leaf tissue, and leave the fields for the overwintering sites in September.

The timing of RWW adult flight in the spring has been monitored for nearly 40 years with a black light trap at the Rice Experiment Station. Monitoring weevil flights is important to determine the levels and intervals of peak flight periods which provides useful baseline data on the timing and intensity of the spring weevil flight. Comparing across years provides a way to estimate population trends for this pest. The switch to an adult control program, i.e., use of post-flood insecticides, has placed even greater importance on understanding RWW flight timing. Prior to 1999, RWW was controlled through the use of a granular insecticide applied before flooding/seeding. The need for application was based on field history and grower perception since the insecticide was applied before planting. In 1999, two insecticides (lambda-cyhalothrin {Warrior® T} and diflubenzuron [Dimilin® 2L]) were registered for RWW and these materials must be applied after seeding and after seedling emergence. They control RWW by altering the deposition of viable eggs. Both products have a short residual and also have minimal effects of RWW larvae, therefore application timing is very important in the efficacy of these products (Univ. of California IPM Project, 1999). A greater understanding of RWW flight, development of field populations, oviposition, egg hatch, etc. is needed to facilitate control efficacy (Godfrey et al 2000).

Materials and Methods: This portion of our work plan was completed as proposed. Fifteen light traps were placed as follows: three in Butte Co., four in both of Sutter and Colusa Co., two in Glenn Co., and one in both of Sacramento and Yuba Co. Trap locations were decided with the

cooperation of the county-based rice Farm Advisors to cover the majority of the rice production region. Approximate trap locations are shown in Figure 1. Traps were placed at the sites in April, before RWW flight. Traps were operated with a 12-volt battery and had a photosensor to activate the light at dusk and switch-off the light at dawn. We investigated the possibility of using solar panels to power the lights, i.e., charge a battery which would run the light at night, but this was not cost-effective. The 12-volt batteries worked satisfactorily. Insects were collected from the traps two to three times per week and the rice water weevils were separated and counted generally within 3 days of collection. The June samples were collected so as to encompass the entire flight period for this insect and the timeliness of counting these was not as critical. Therefore, they were quantified in July. The traps were very effective in capturing insects and certain traps during some 2-3 day periods captured ~3 gallons (several pounds) of insects. Recovering the “few” (generally at most 30-100) rice water weevil adults (2-3 mm in length) was very time-consuming.

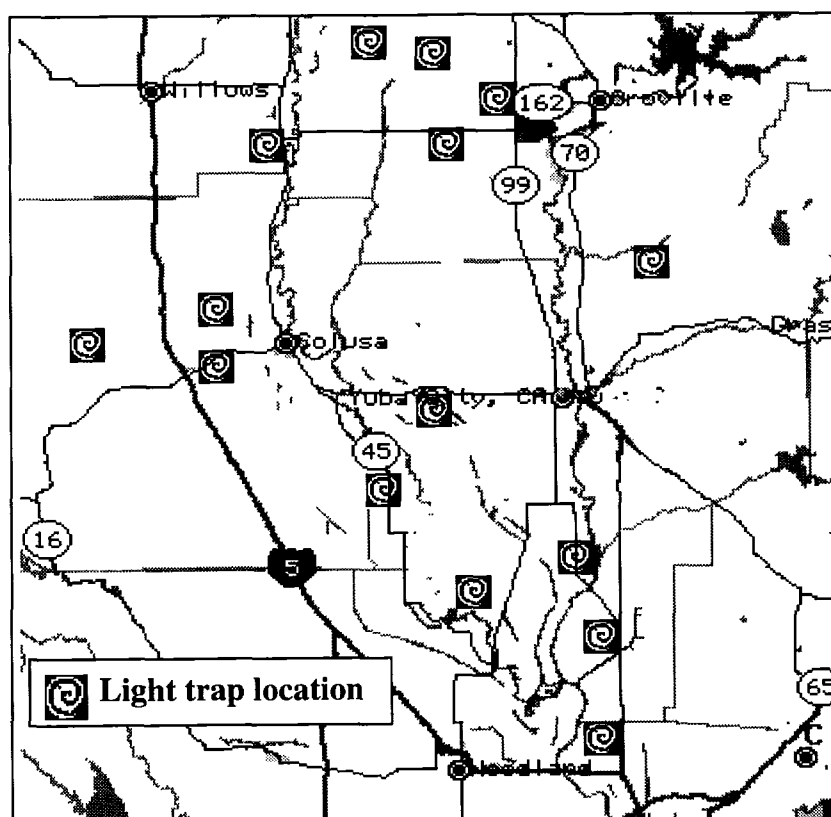


Figure 1. Approximate locations of light traps used to monitor RWW flight in the Sacramento Valley rice production area, 2000.

Data were placed on the UC Cooperative Extension Rice web site (<http://agronomy.ucdavis.edu/uccerice/product/rwwtrap.htm>) in a timely fashion. We did not quantify use of these data, but I know several growers relayed to me that they accessed the site and looked at/utilized the data. We also faxed the results to the Rice Farm Advisors in the county offices so they could further distribute them. An example of the web site appearance is

shown in Fig. 2.

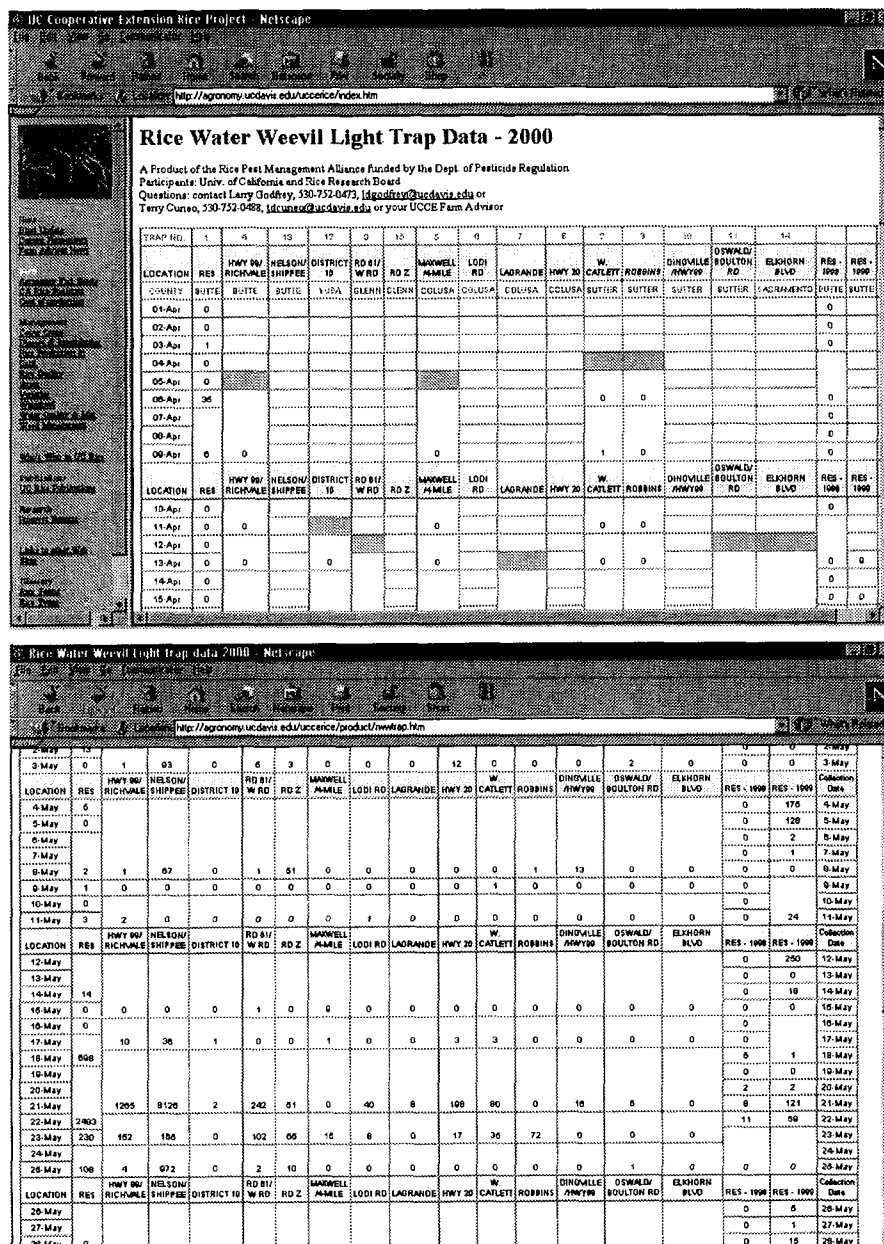


Figure 2. Examples of data presentation on web site.

Results: The total number of RWW adults collected in light traps for 2000 was 18,105. Results from the light trap catches indicated that the first flight in Butte county began at the end of the first week of April and in the other counties around the third week in April. Some major flight peaks for all sites were 20 April and 23 April through 8 May and again in mid-May (17 to 24 May) when there was a high, distinct peak in flight. The highest flights in Colusa and Glenn counties for a 2-day collection period were around 27 April at 311 and 345 RWW, respectively. In Butte and Sutter counties, a 4-day collection on 21 May yielded 8126 and 98 RWW, respectively. The timing of peak flight and incidence of flight for each trap is shown in Fig. 3.

Overall, the flight incidence was higher in the northern counties than other areas. In some areas that reportedly did not have a problem with this pest, i.e., Sutter Basin, there were still numerous RWW captured. The trap in District 10 collected very few RWW, as anticipated. The trap in Sacramento County collected only 6 RWW during the entire period; however, this trap was located about 200 yards from an area where we hand-collected several thousand RWW for studies during 1996-98. RWW flight generally occurred earlier (peaked in April) at the “perimeter” of the Valley as opposed to the interior which peaked in May. A summary of flight incidence by county is shown in Fig. 4. RWW spring flight totals for the light traps at cooperating grower farms involved were for Butte, 11,474; Colusa, 859; Glenn, 1,178; Yuba, 18; Sacramento, 6 and Sutter, 410.

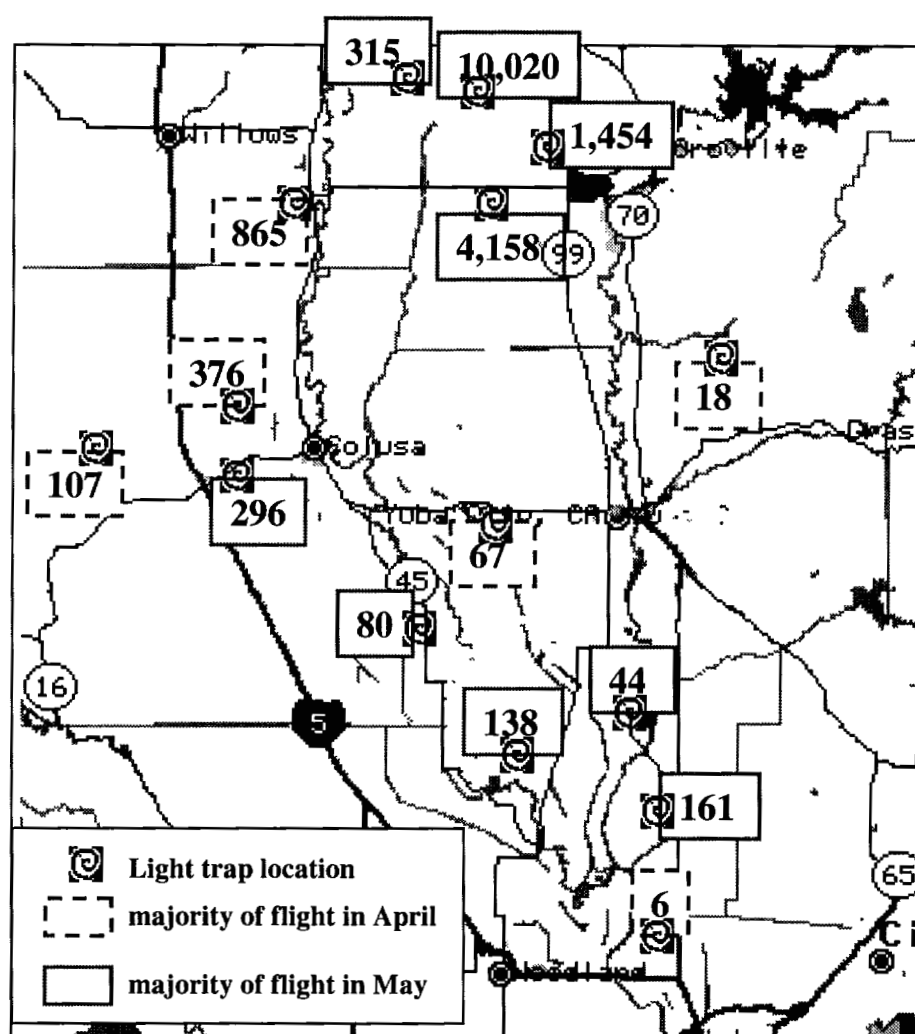


Figure 3. Summary of RWW flight timing and incidence in light traps used to monitor RWW flight in the Sacramento Valley rice production area, 2000.

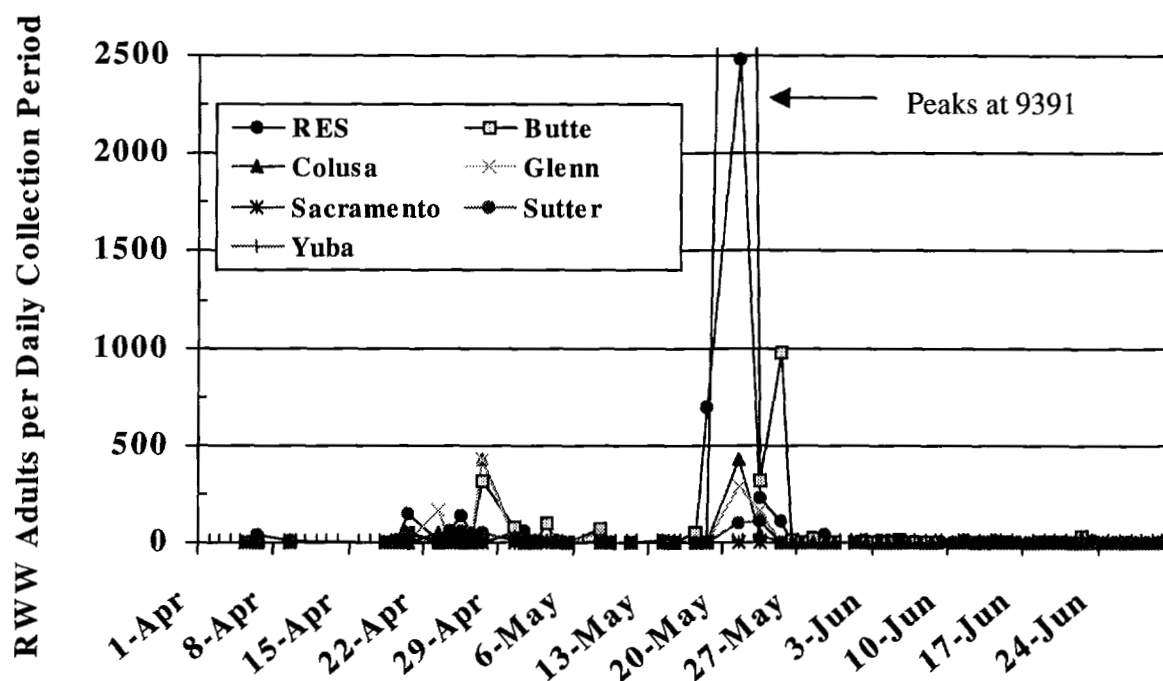


Figure 4. RWW flight incidence summarized by county, Sacramento Valley rice production area, 2000.

The long-time light trap used for monitoring RWW flight is at the Rice Experiment Station in Butte County and this provides a point for comparison to past years. The trap at the Rice Experiment Station (RES) had its highest peak on 22 May at 2,483 RWW, about 1 week later than in 1999 (Fig. 5). Calculating when 90% of the flight was completed provides a means of comparing flight across years. The date when 90% of the flight was completed for RES was about 23 May, compared with 30 May in 1999 (Fig. 6). The total RWW captured at RES in 2000 was 4,158, about 3.6X higher the 1999 count of 1,149. Some slight activity also occurred in late April. Compared with 1998 and 1999, RWW flight was greater in numbers and more concentrated in 2000. Therefore, 2000 could be classified, in terms of RWW flight, as a slightly earlier year and higher in number.

Discussion: The study was successfully completed and the data were interesting and useful. Some general trends in RWW flight patterns were noted. Growers and PCAs also found the data interesting in terms of documentation of regions of the rice production area with high weevil pressure, particular timings of seedling emergence that coincided with periods of high RWW flight, etc. However, in terms of using these flight data to schedule treatments (need for and timing of applications), the data were of limited use. Local conditions, down to the individual field level, dictate RWW populations. In-field monitoring is needed to accomplish this goal of scheduling treatments. The existing threshold that was developed for post-flood applications of Furadan is not adequate for Warrior or Dimilin. By the time the threshold is met, the eggs have been deposited and are unaffected by the treatment. Therefore, additional work is needed to develop a viable threshold. The light trap data are interesting and useful to reinforce

individual field data, but by themselves the light trap data are not adequate.

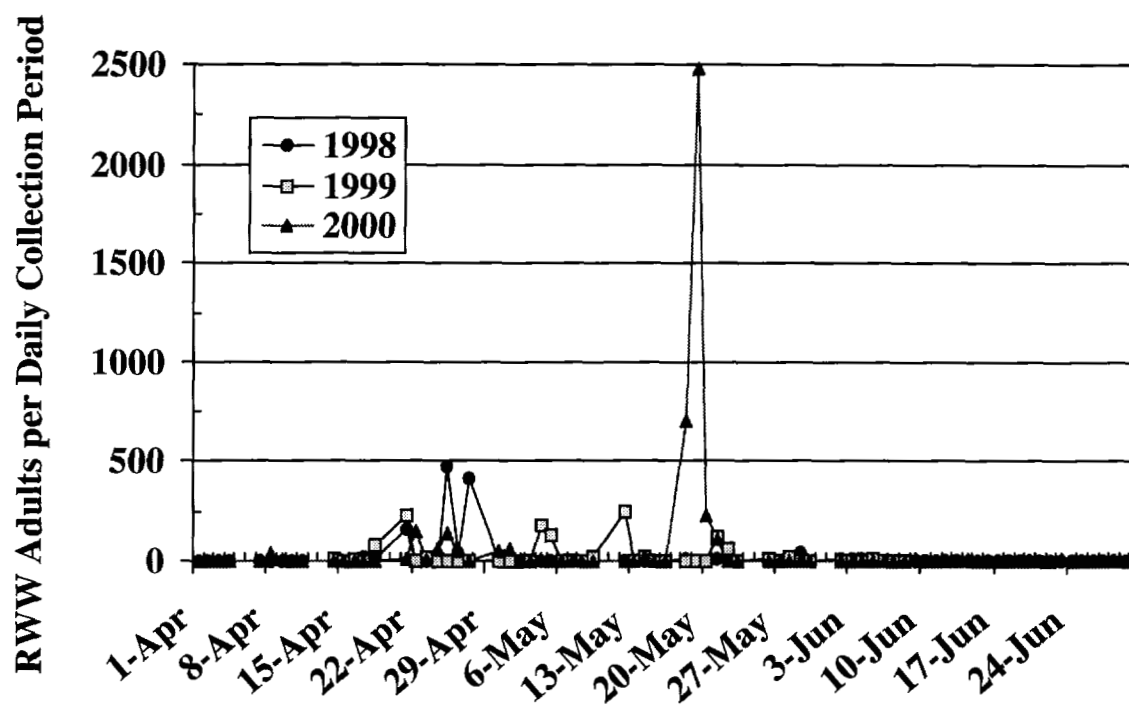


Figure 5. RWW flight incidence at the Rice Experiment Station, Butte Co., 1998, 1999, and 2000.

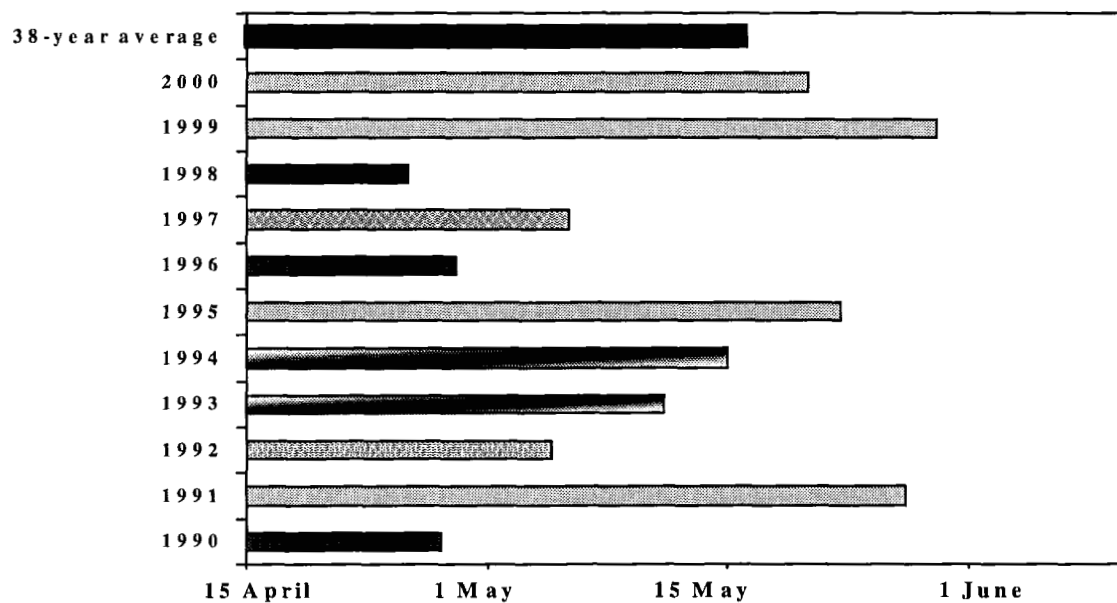


Figure 6. Comparison of the length of the RWW flight period (completion of 90% of the flight), 1990 to 2000, Rice Experiment Station.

Summary and Conclusions: The Rice Water Weevil, *Lissorhoptrus oryzophilus*, (RWW) is the most important insect pest of rice in California. Feeding by the larval stage of this insect on rice plant roots can reduce grain yield by up to 30%. Biological control and host plant resistance in the rice plant are nonexistent for this pest, although efforts and progress has been made in the latter area. Cultural control measures are useful to provide partial control, although these methods all have drawbacks such as potential to reduce yields, increased weed problems, increased production costs for fuel, etc. Therefore, insecticides are an important tool for the management of this pest. Carbofuran (Furadan® 5G) has typically been applied to 30-40% of the acres to manage this pest. The registration of this product has been under scrutiny since the early 1990's and in 1999 two new products were registered for RWW control. Therefore, 1999 was the last year of significant carbofuran use in rice (on-hand inventories were used in 2000). Furadan was applied pre-plant to rice fields; the two new products (Warrior® T and Dimilin® 2L) are applied after flooding and seedling emergence. Unlike Furadan (which killed RWW larvae), the effects of these new products is aimed at the adult RWW; they control RWW by preventing the deposition of viable RWW eggs. The occurrence of the damaging larval stage is hopefully prevented by stopping the deposition of RWW eggs. Dimilin and Warrior both have a short residual on the pest (less than 1 week). Therefore, the application has to be timed properly to facilitate control - too early and the material has dissipated too soon whereas with an application made too late and the RWW adults have already deposited eggs. Our results in small plot studies and grower fields have been promising with these products.

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References

- Godfrey, L. D. and A. T. Parang. 1996. Rice yield response to rice water weevil infestation in California - 1993-95. Proc. Twenty-sixth Rice Technical Working Group, San Antonio, TX, p. 117.
- Godfrey, L. D., T. D. Cuneo, and C. L. Alexander. 2000. Refined understanding of rice water weevil biology to optimize management efficacy. Proc. Twenty-eighth Rice Technical Working Group, San Antonio, TX, p. 72-73.
- Univ. of California IPM Project. 1999. UC Pest Management Guidelines: Rice - Invertebrates, L. Godfrey, UC DANR Publication 3339.

List of Publications Produced

Results from this project were presented as a poster at the Rice Experiment Station Field Day in Aug. The participants in this field day generally number about 500 growers, PCAs and others involved with the industry. An abstract was also written with these result. A summary of the results was included in the annual reports (verbal and written) to the Rice Research Board (the Board has historically provided funding for the trap at the Rice Experiment Station).